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CORONA EFFECT ON TRANSMISSION LINES

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ABSTRACT

The system of generation of electricity is generated at 11 kv universally adopted, then the process of transmission and distribution of electrical energy will be trough to different types of customers may be commercial, industrial and domestic. After complete process transmission line lose has been taken place in the form of corona loss and ohite losses.

In this paper a brief idea about corona loss, hoe reduces of corona loss will be discussed. Due to this loss energy type of consumers has facing the problem of less electricity more till. It is a reason of financial losses of electrical industries.

Availability of electric power has been most powerful that to provide industrial, domestic and commercial for any country. Electric power is transmitted trough transmission line which delivers a large amount of power from generating stations to load canters and different types of consumers.

In this paper, a mathematical model of losses through transmission line was developed for corona loss and ohmic loss.

KEYWORDS: Corona, Transmission Line Losses, Skin Effect, Critical Disruptive Voltage, Visual Critical Voltage

INTRODUCTION

Electrical energy is generated at power station which are located faraway from different types of load centers. Through a network is develop from one place to required place by using conductors ie transmission line, then distribution of electrical energy. Knowledge of power losses on transmission line and how to reduce these loses is a main component for different flow of power in any electrical network.

General Concept of Basic Corona and Transmission Lines

Transmission Line Losses, includes various losses namely conductor loss, radiator losses, ohmic loss and corona losses etc.

Skin Effect

The tendency of alternating current to spread out on the outer surface of conductor is greater than that its central part or its care, then the resistance of the conductor is increase ie 1.6 of the resistance called skin effect.

If resistance if conductors is increase the ohmic loss (I^2R) will also increase properly.

Corona

The phenomenon of violet glow, hissing noise and production of ozone gas is an overhead transmission line is called as **corona.** If the conductors are smooth and polished, the corona glow will be uniform otherwise, the rough plots will be appear brighter is as but in dc voltage, this problems is less in comparative to ac voltage

Critical Disruptive Voltage

The phenomenon of corona plays an important role in the design if an overhead transmission line. Therefore some terms are important as critical disruptive voltage, discussed below:-

It is the **minimum phase-to-phase neutral** voltage at which the corona occurs.

Mathematically

$g_v = g_o .\delta. (1+0.3/\sqrt{r}\ \delta)$ Kv/cm

Where g_o = Breakdown strength of air is 76 cm pressure temperature of 25^0C is 30 kv/cm (maximum). Or 21.2 kv/cm (rms), and is denoted by g_o, so,

$Vc = g_o.r.\log_e d/r$

= Critical disrupt line voltage

δ = air density factor

= 3.92b/(273+t)

Under standard condition, the value of δ is taken as unity (1) therefore

$Vc = g_o .\delta.r.\log_e d/r$

As per as surface condition if conductor, the expression is multiplied by the regulating factor mo.

Finally, after consider overall, the critical disruptive voltage i.e. Vc

($Vc = m_0 g_0\ \delta.r \log_e\ d/r$ kv/phase)

Where m_0 = for polished conductors

= 0.98 to 0.92 for dirty conductor

= 0.87 to 0.8 for stranded conductor.

Visual Critical Voltage

It is defined as the minimum phase- natural voltage at which corona glow appears all the line conductors or mathematically.

$Vv = rm_v\ g_0 \ln d/r$ kv $= 21.1 m_v r\ \delta(1+0.3/\sqrt{r}\ \delta) \ln d/r$ KV (rms)

Power Loss Due to Corona

Presence of corona is always buildup by energy loss which s dissipated in form of light, heat, should and chemical action. When disruptive voltage is exceeded, the power loss to corona is given by

$P = 241x(f + 25 / \delta) \sqrt{r/d}\ (V_p - V_c)^2 \times 10^{-5}$ kw/km/phase

Where f = supply frequency in hz.

V_p = Phase to neutral voltage in rms.

Vc = Disruptive - voltage per phase in rms.

How to Reduce Corona

Corona can be reduced by the following methods discussed below.

By Increased Conduction Size

If the size of conductor is increase, then the voltage at which corona occurs is raised and hence for corona effects takes place. This is one of the best method to reduce the corona loss, for this purpose, ACSR conductors which has larger-cross sectional area are used in transmission line.

By Increasing Conductor Spacing

If the space between the conductors is increased, the voltage at which the corona occurs is raised and therefore corona effects can be eliminated.

Study of HVDC Regarding Corona Effects

Electrical energy transmission has been done in two modes HVDC and HVAC but HVDC is more effective

Advantage of HVDC

- In HVDC large power for conductor and this conductors are required.
- HVDC, system has simple line construction.
- Every conductor can be used as an independent currant.
- In HVDV, there is no charging current.
- In HVDC, there is no skin effect.
- In HVDC, line power factor is always unity.
- In HVDC, less corona loss.
- For HVDC, distance is not limited by stability point of view.
- There is no stability problem in HVDV.

Disadvantage of HVDC

- In HVDC, transmission extra equipment are needed. So it is more costly w.r.t. to HVAC.
- HVDC, converter has low overload capacity.
- In HVDC, maintains of insulator is more.
- The use of circuit breaker in HVDC transmission line system is more difficult and expensive.

Consider Example

A 3-Phase, 220 kV, 50 Hz transmission line consists of 30 mm diameter conductor spaced 2.5 meters apart in the form of an equilateral triangle. In the temperature is 38^0C and atmospheric pressure is 76 cm, calculate the corona loss per km of the line. Assume the irregularity factor as 0.83.

Solution Given

$f = 50$ Hz; $r = 30/2 = 15$mm $= 1.5$ cm; $D = 2.1$m $= 210$cm; $t = 38^0$C; $b = 76$cm, $m_0 = 0.83$

Corona Loss per km of the Line, P

We know that, corona loss is given by,

$P = (241 \text{ X } 10^{-5})(f+25/\delta)\ \sqrt{r/D}\ \ (V_{ph} - V_c)^2$ kV/km/phase

Where $\delta = 3.92b/(273+t)$

$= 3.92 \text{ X } 76/273 + 38 = 0.958$

Assuming $g_0 = 21.1$ kV/cm (r.m.s.), we have critical disruptive voltage,

$V_c = g_0\,\delta\, m_0 r \text{ In } (D/r)$ kV / phase

$= 21.21 \text{ X } 0.958 \text{ X } 0.83 \text{ X } 1.5 \text{ X In } (210/1.5) = 125$ kV/phase

Supply voltage per phase, $V_{ph} = 220/\sqrt{3} = 127$ kV

Substituting the values, we get

$P = (241 \text{ X } 10)\ (50 + 25/0.958)\ \sqrt{\frac{1.5}{210}}\ (127\text{-}125)^2 = 0.0638$ kW/km/phase

Total corona loss per km for three phases

= 3 X 0.0638 = 0.1914 kW.

CONCLUSIONS

Corona in transmission line causes power loss reducing transmission efficiency. The total power loss will be more in bad atmospheric condition as compared fair wheather. The only way to reduce or prevent corona is to have corona inception voltage higher than the phase voltage and it should be increased by by increasing space between conductors and by increasing the radius of conductors. Second method to prevent corona loss is more effective, a higher conductor radius means for the same conductor voltage and electric field stress becomes less. An ACSR will have lower corona loss compared to copper conductors.

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